Importation of Fresh Cape Gooseberry Fruit (*Physalis peruviana* L.) into the Continental United States from Ecuador

A Qualitative, Pathway-Initiated Risk Assessment

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Version 2

Agency Contact
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Executive Summary

The Animal and Plant Health Inspection Service of the United States Department of Agriculture prepared this pest risk assessment to examine plant pest risks associated with the importation of fresh field-grown fruit of Cape gooseberry, *Physalis peruviana* L., with or without husk, from the Republic of Ecuador into the continental United States. We developed a list of pests associated with Cape gooseberry (in any country) that occur in Ecuador on any host, based on scientific literature, previous Plant Protection and Quarantine commodity risk assessments, records of intercepted pests at ports-of-entry, information from specialized databases, and the opinion of experts in Cape gooseberry production.

We identified one quarantine pest likely to follow the pathway of Cape gooseberries imported from Ecuador: *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae). We found that the pest risk potential was **High** for this pest. Specific phytosanitary measures beyond port-of-entry inspection are strongly recommended for this pest. The selection of appropriate measures to mitigate risk is part of the risk management phase and is not addressed in this document.

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Introduction

1.1. Background

This document was prepared by the Plant Epidemiology and Risk Analysis Laboratory of the Center for Plant Health Science and Technology, USDA Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), in response to a request to evaluate the risks associated with the importation of commercially produced fresh fruit of Cape gooseberry, *Physalis peruviana* L., from Ecuador into the continental United States.

The International Plant Protection Convention (IPPC) provides guidance for conducting pest risk analyses. The methods used here are consistent with guidelines provided by the IPPC, specifically the International Standard for Phytosanitary Measures (ISPM) on ‘Pest Risk Analysis for Quarantine Pests, Including Analysis of Environmental Risks and Living Modified Organisms’ (IPPC, 2009: ISPM #11). The use of biological and phytosanitary terms is consistent with the ‘Glossary of Phytosanitary Terms’ (IPPC, 2009: ISPM #5).

Three stages of pest risk analysis are described in international standards: Stage 1, Initiation; Stage 2, Risk Assessment; and Stage 3, Risk Management. This document satisfies the requirements of Stages 1 and 2.

This is a qualitative risk analysis; estimates of risk are expressed in terms of High, Medium, and Low pest risk potentials based on the combined ratings for specified risk elements (PPQ, 2000) related to the probability and consequences of importing Cape gooseberry from Ecuador. For the purposes of this assessment High, Medium, and Low probabilities will be defined as:

High: More likely to occur than not to occur
Medium: As likely to occur as not to occur
Low: More likely not to occur than to occur

The appropriate risk management strategy for a particular pest depends on the risk posed by that pest. Identification of appropriate sanitary and phytosanitary measures to mitigate the risk, if any, for this pest is undertaken as part of Stage 3 (Risk Management). Other than listing possible mitigation options for the pests of concern, we did not discuss risk management in this document.

1.2. Commodity Information

1.2.1. Production

The best potential growing zones for this crop in Ecuador are in the inter-Andean valleys (MAG and IICA, 2001), in the following provinces: Carchi, Imbabura, and Pichincha in the northern region; Cotopaxi, Tungurahua, and Chimborazo in the central region; and Azuay and Loja in the southern region (SESA, 2007). In Ecuador, the Pichincha and Tungurahua provinces grow Cape gooseberry for exportation (SESA, 2007). The estimated average annual yield for a commercial crop is 8-12 metric tons (Vallejo, 2001). Ecuador exported 11 metric tons of fresh Cape gooseberry to other countries (Europe mainly) in 2006 (SESA, 2007).

1.2.2. Standard harvest and post-harvest processing

Cape gooseberries are harvested when the fruits are physiologically and commercially mature, when the color of the fruits and husks is yellow-green or yellow (SESA, 2007). The fruits are usually handpicked, at the height of the peduncle near its insertion in the stem (maximum 2 cm of peduncle is left with the husk), with disinfected scissors. Once transported to the packing place, the fruits are individually classified, and the husks are opened in to eliminate fruits affected by pathogens, insects, and/or physical, physiological, or mechanical damage. The husks are then closed with the extremities of the sepals (the husks) not joined and the fruits are left on clean surfaces at room temperature to dry for 24 to 48 hours (SESA, 2007). Afterwards, they are sorted by size (with or without husks) and packed in small plastic baskets that are arranged in cardboard boxes and then exported by air. The fruits can be stored at 4 to 8°C (39.2 to 46.4°F), with a relative humidity of 80 to 90 percent (MAG and IICA, 2001).

2. Risk Assessment

We began the pest risk assessment by identifying the initiating event, screening for weed potential, and discussing the decision history. We then identified and characterized the pests reported as attacking Cape gooseberry in any part of the world and present in Ecuador, then analyzed the quarantine pests that are likely to follow the pathway.

2.1. Initiating Event: Proposed Action

This commodity-based, pathway-initiated assessment is in response to a request made by the Ecuadorian Animal and Plant Health Service (SESA, 2006) to the USDA for authorization to allow imports of fresh Cape gooseberry (fruits with or without husk) to the continental United States. The importation of fresh Cape gooseberry grown in Ecuador is a potential pathway for introduction of plant pests. Title 7 of the Code of Federal Regulations 319 Part 56 (7 CFR § 319, 2009) provides regulatory authority for the importation of fruits and vegetables from foreign sources into the United States.

2.2. Assessment of Weed Potential of Cape gooseberry

The results of the weed potential for Cape gooseberry did not prompt a weed-initiated risk assessment (Table 1).

Table 1. Assessment of the weed potential of *Physalis peruviana*, Cape gooseberry.

Scientific name and author: *Physalis peruviana* L.
Synonyms: *Alkekengi pubescens* Moench, *Boberella peruviana* (L.) E.H.L. Krause, *Boberella pubescens* (L.) E. H. L. Krause in Sturm, *Physalis chenopodifolia* Lam., *Physalis edulis* Sims, *Physalis esculenta* Salisb., *Physalis latifolia* Lam., *Physalis peruviana* var. *latifolia* (Lam.) Dunal, and *Physalis tomentosa* Medik. (Missouri Botanical Garden, 2011).
Plant family: Solanaceae.
Common names: Andean Cherry, Cape Gooseberry, Goldenberry, Gooseberry-tomato, Husk

Tomato, Peruvian groundcherry, Physalis, Uchuva (Ligarreto et al., 2005; MAG and IICA, 2001; USDA and ARS, 2011; PPQ, 2006).

Phase 1: Distribution in the United States

Physalis peruviana is reported as introduced in six separated states of the continental United States: Alabama, Arkansas, California, Kentucky, Massachusetts, and New Jersey (Kartesz, 2011; NRCS, 2011), and therefore considered to be widely distributed in the continental United States.

Phase 2: Invasive / Weed Status: Listing as weed

No	FLEPPC, 2009; Gunn and Ritchie, 1988; Holm et al., 1977; Holm et al., 1997; PPQ, 2006; Reed, 1977; Rice, 2011
Yes	Holm et al., 1979; ISSG, 2011; Randall, 2007; Swearingen, 2011; Weber, 2003; US Forest Service, 2010

Phase 3: Summary and Conclusion

Cape gooseberry is widely prevalent in the continental United States and reported as an invader in six of the references listed in phase 2. In this case, per the APHIS Guidelines for Pathway-Initiated Pest Risk Assessments, Version 5.02 (PPQ, 2000), additional comments on findings in text are provided.

In the *Geographical Atlas of World Weeds*, *P. peruviana* is listed as a common weed in Hawaii, Indonesia, Kenya, and Rhodesia, and as a weed of unknown importance in Australia, Fiji, India, New Zealand, Peru, West Polynesia, and the United States (Holm et al., 1979). In *Global Compendium of Weeds* (Randall, 2007), *P. peruviana* is considered a weed for Australia, Ecuador (Galapagos islands), New Zealand, Rhodesia, South Africa, and Tasmania. In the Alien Plant Invaders of Natural Areas database (Swearingen, 2011), *P. peruviana* is listed as a weed for the U.S. state of Hawaii. In *Invasive Plant Species of the World* (Weber, 2003), *P. peruviana* is described as a plant that can invade forests, forest edges, riparian habitats, and disturbed sites, and form dense thickets that crowd out native vegetation. In the Pacific Island Ecosystems at Risk (PIER) database, it is considered naturalized in Hawaii in disturbed sites in mesic to wet forest, diverse mesic forest, and subalpine woodland; a common weed in Niue in some plantations; an occasional plantation weed in Tonga; and widely widespread as weed in New Caledonia (US Forest Service, 2010).

Physalis peruviana is listed as a world economic plant that it is widely naturalized and cultivated for its edible fruits (Wiersema and Leon, 1999). It has been introduced into the United States in Florida for crop production (Morton, 1987).

Conclusion: Because Cape gooseberry is already widely distributed and naturalized in the United States, importation of fresh fruit from Ecuador should not increase the weed potential beyond that existing at present. Therefore the pest risk assessment proceeds.

2.3. Decision History, Current Status, and Pest Interceptions

2.3.1. Decision History

In 1988, an import request from Ecuador for the entry of Cape gooseberry was denied due to the absence of acceptable treatment options for *Ceratitis capitata* (CPHST, 2011). Two pest risk assessments have been completed to date for the importation of Cape gooseberry from Colombia and Chile (PERAL, 1997; PERAL, 2011). The pest risk assessment from Colombia identified one quarantine pest, (*Ceratitis capitata*) that could be introduced into the continental United States via this pathway (PERAL, 1997). The PRA for Cape gooseberry from Chile did not identify any quarantine pests likely to follow the pathway (PERAL, 2011).

2.3.2. Current Status of Importations

Currently, Title 7, Part 319, Section 56 of the U.S. Code of Federal Regulations (7 CFR §319.56) does not permit the importation of fresh Cape gooseberry for human consumption from Ecuador into the continental United States.

Cape gooseberry is only authorized to enter into the United States through all U.S. ports-of-entries from Colombia (fruit with or without husk) under T107-a (cold treatment), and from New Zealand without any treatment (APHIS, 2011).

2.3.3. Pest Interceptions

Pest species intercepted between 1985 and 2011 on Cape gooseberry entering the United States are listed in Appendix A. Thirty-two different species of pests were intercepted 64 times (PestID, 2011). Of these pests, the only pest reported at species level and present in Ecuador is *Aleurodicus dispersus*. Several pests have been intercepted that are not listed below for various reasons. For instance, we did not list organisms identified only to the family level. We also did not include species of Asteraceae because they are plants/weeds that are highly unlikely to move with the commercial commodity after harvest and post-harvest processing.

2.4. Pest Categorization—Identification of Pests

2.4.1. Pests associated with Cape gooseberry in Ecuador

Below we list the pests associated with Cape gooseberry (in any country) that occur in Ecuador on any host (Table 2). In this list we identify 1) the pest's scientific name, 2) the presence of pests in Ecuador and the United States, 3) the reference(s) that report the pest on the host, 4) the quarantine status of the pest in the United States, 5) the generally affected plant part or parts, and 6) if the pest is likely to follow the pathway into the United States on Cape gooseberry fruit. Each pest report has the pertinent citation(s) for the distribution, record on the host, and plant part association.

Many organisms on Cape gooseberry fruit from Ecuador are not sources of phytosanitary risk because they do not satisfy the definition of a quarantine pest. A quarantine pest is defined as "a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (IPPC, 2009: ISPM No. 5). We used the abbreviation N/A (not applicable) for non-quarantine pests under the headings "Plant part association" and "Follow pathway." Even if non-quarantine pests are able to follow the pathway, phytosanitary measures against these pests would not be justified considering the pest already occurs in the United States; therefore, information on plant part association and whether the pest is likely to follow the pathway is not needed for non-quarantine pests.

Table 2. Pests reported on Cape gooseberry (*Physalis peruviana*) fruit with or without husk, anywhere in the world and reported as present in Ecuador.

Pest Scientific Name	Geographic distribution[1]	Reported on *P. peruviana*	Quaran-tine pest[2]	Plant part association[3]	Follow pathway
ARTHROPODS					
ARACHNIDA					
Acari: Eriophyidae					
Aculops lycopersici (Tryon)	EC (Rogg, 2000); US (CABI, 2011)	CABI, 2011; EPF and FAO, 2006; Saenz and Getiva, 2003	No	N/A	N/A
Acari: Tarsonemidae					
Polyphagotarsonemus latus Banks	EC (MAF, 1999); US (CABI, 2011)	Chia et al., 1997	No	N/A	N/A
Acari: Tetranychidae					
Tetranychus desertorum Banks	EC (Rogg, 2000); US (Bolland et al., 1998)	Bolland et al., 1998	No	N/A	N/A
Tetranychus evansi Baker & Pritchard	EC (Rogg, 2000); US (Bolland et al., 1998; CABI, 2011)	Bolland et al., 1998	No	N/A	N/A
Tetranychus ludeni Zacher	EC (Fazzio et al., 2005); US (Bolland et al., 1998; Jeppson et al., 1975)	Bolland et al., 1998	No	N/A	N/A
Tetranychus urticae Koch	EC (MAG, 1986); US (Bolland et al., 1998)	Bolland et al., 1998	No	N/A	N/A
INSECTA					
Coleoptera: Chrysomelidae					
Diabrotica speciosa (Germar)	EC (MAG, 1986; Rogg, 2000)	Bado et al., 2005	Yes	I (Bado et al., 2005)	No
Epitrix cucumeris (Harris)	EC (CABI, 2011); US (Arnett Jr., 2000; CABI, 2011)	Benavides and Mora, 2005	No	N/A	N/A
Epitrix sp.	EC (MAG and IICA, 2001)	MAG and IICA, 2001	Yes	L (Angulo, 1988; SESA and CORPEI, 2005)	No

[1] Geographic Distribution: EC = Ecuador; US = United States (specific states are listed for quarantine pests with limited distribution: CA = California; FL = Florida; LA= Louisiana).
[2] Brackets indicate a quarantine-significant species with limited distribution in the United States (PestID, 2011).
[3] Fr = Fruit; I = Inflorescence/Flower; H = Husk; L = Leaf; R = Root; Sd = Seed; Sh = Shoot; S = Stem

Pest Scientific Name	Geographic distribution[1]	Reported on *P. peruviana*	Quarantine pest[2]	Plant part association[3]	Follow pathway
Coleoptera: Elateridae					
Agriotes lineatus Linnaeus	EC (Brito, 2002); US (CABI, 2011)	Brito, 2002	No	N/A	N/A
Agriotes obscurus Linnaeus	EC (Brito, 2002)	Brito, 2002	Yes	R (Brito, 2002)	No
Agriotes sputator Linnaeus	EC (Brito, 2002)	Brito, 2002	Yes	R (Brito, 2002)	No
Diptera: Agromyzidae					
Liriomyza huidobrensis (Blanchard)	EC, US (CA) (CABI, 2011)	Vergara, 1986	[Yes][4]	L (Vergara, 1986)	No
Liriomyza quadrata (Malloch)	EC (Spencer, 1973)	Vergara, 1986	Yes	L (Vergara, 1986)	No
Diptera: Tephritidae					
Ceratitis capitata (Wiedemann)	EC (CABI, 2011; Tigrero, 1998)	CABI, 2011; Liquido et al., 1991	Yes	Fr (CABI, 2011)	Yes
Hemiptera: Aleyrodidae					
Trialeurodes vaporariorum (Westwood)	EC (Cano, 1999); US (CABI, 2011; Hodges and Evans., 2005)	Angulo, 2003; Cano, 1999; Vergara, 1986	No	N/A	N/A
Hemiptera: Aphididae					
Aphis gossypii Glover	EC (MAG, 1986; Vaughan, 1982); US (CABI, 2011)	Angulo, 2003	No	N/A	N/A
Aphis sp.	EC (Brito, 2002)	Brito, 2002; CAF, 1992	Yes	L (Brito, 2002)	No
Cavariella aegopodii (Scopoli)	EC (Brito, 2002)	Brito, 2002	Yes	L (Brito, 2002)	No
Macrosiphum euphorbiae (Thomas)	EC, US (CABI, 2011)	Bado et al., 2005; Vergara, 1986	No	N/A	N/A
Myzus persicae (Sulzer)	EC (Brito, 2002); US (CABI, 2011)	Brito, 2002	No	N/A	N/A
Pemphigus sp.	EC (Brito, 2002)	Brito, 2002	Yes	R (Brito, 2002)	No
Hemiptera: Coreidae					
Phthia picta (Drury)	EC (Rogg, 2000); US (Baranowski and Slater, 1986)	Bado et al., 2005	No	N/A	N/A
Hemiptera: Diaspididae					
Aspidiotus destructor Signoret	EC, US (Ben-Dov et al., 2011)	Ben-Dov et al., 2011	No	N/A	N/A
Hemiptera: Miridae					

[4] Although *L. huidobrensis* has been reported as occurring in the United States in California (CABI, 2011), it is a quarantine pest for the United States because genetic analyses have confirmed that flies identified by this name and collected from California (CABI, 2011) really refer to *L. langei* Frick, which is a cryptic species within *L. huidobrensis* (Scheffer, 2000; Scheffer, 2004; Scheffer and Lewis, 2001; Scheffer et al., 2001).

Pest Scientific Name	Geographic distribution[1]	Reported on *P. peruviana*	Quarantine pest[2]	Plant part association[3]	Follow pathway
Dicyphus cucurbitaceus (Spinola) Carvalho Syn.: *Tupiocoris cucurbitaceus* (Spinola)	EC (MAG, 1986)	Bado et al., 2005	Yes	L (Bado, 2007)	No
Hemiptera: Ortheziidae					
Insignorthezia insignis (Browne)	EC, US (Ben-Dov et al., 2011)	Ben-Dov et al., 2011	No	N/A	N/A
Hemiptera: Pentatomidae					
Edessa meditabunda (Fabricius)	EC (Rogg, 2000)	Bado et al., 2005	Yes	L, S (Bado, 2011)	No
Lepidoptera: Gelechiidae					
Phthorimaea operculella (Zeller)	EC, US (CABI, 2011)	CABI, 2011; Robinson et al., 2007	No	N/A	N/A
Tuta absoluta (Meyrick) Povolny	EC (MAG, 1986; Vaughan, 1982)	Angulo, 2003	Yes	L, Sh (Angulo, 2003)	No[5]
Lepidoptera: Noctuidae					
Agrotis ipsilon (Hufnagel)	EC (MAG, 1986, Vaughan, 1982); US (CABI, 2011)	Avila and Forero, 1989; Vergara, 1986	No	N/A	N/A
Agrotis sp.	EC (MAG and IICA, 2001)	Brito, 2002; CAF, 1992; MAG and IICA, 2001	Yes	L, S (GPP, 2004)	No
Copitarsia decolora Guenée Syn.: *C. turbata* (Herrich-Shaeffer)	EC (Angulo and Olivares, 2003; Angulo and Olivares, 2010)	Díaz et al., 2010; Martínez et al., 2010	Yes	L, I, Fr (H), Sh (Martínez et al., 2010)	No[6]
Feltia sp.	EC (Brito, 2002)	Brito, 2002	Yes	L, S (Brito, 2002)	No
Helicoverpa zea (Boddie)	EC, US (CABI, 2011)	Robinson et al., 2007	No	N/A	N/A
Heliothis sp.	EC (MAG and IICA, 2001)	MAG and IICA, 2001; SESA and CORPEI, 2005	Yes	Fr, I, L (SESA and CORPEI, 2005)	Yes
Heliothis subflexa Guenée	EC (Narváez, 2003); US (CABI, 2011)	CABI, 2011; Narváez, 2003; Vergara, 1986	No	N/A	N/A
Heliothis virescens (Fabricius)	EC (MAG, 1986); US (CABI, 2011)	Figueroa, 1977	No	N/A	N/A

[5] *T. absoluta* is a pest of tomato fruit (EPPO, 2005), but it only attacks the foliage and buds of Cape gooseberry (Angulo, 2003). Furthermore, it has not been intercepted on Cape gooseberries (PestID, 2011). If we find conclusive evidence that *T. absoluta* damages husks and fruits, we may analyze it.

[6] *C. decolora* only affects newly tissues such as foliar shoots, floral buds, and young fruits growing inside the husk (first stages) (Martínez et al., 2010). Young fruit are highly unlikely to be harvested, and affected fruits will be easily detectable and culled during standard harvest and post-harvest processing.

Pest Scientific Name	Geographic distribution[1]	Reported on *P. peruviana*	Quarantine pest[2]	Plant part association[3]	Follow pathway
Spodoptera frugiperda J.E. Smith	EC, US (CABI, 2011)	Angulo, 2003; Condoy and Arteaga, 2006	No	N/A	N/A
Lepidoptera: Sphingidae					
Manduca sexta (Linnaeus)	EC, US (CABI, 2011)	Bado et al., 2005	No	N/A	N/A
Orthoptera: Grillidae					
Gryllus assimilis Fabricius	EC (MAG, 1986); US (Arnett Jr., 2000; CABI, 2011; Walker, 2003)	Avila and Forero, 1989	No	N/A	N/A
Thysanoptera: Thripidae					
Frankliniella panamensis Hood	EC (MAG, 1986)	Zapata et al., 1994	Yes	L (Zapata et al., 1994)	No
Thrips tabaci Lindeman	EC (MAG, 1986); US (CABI, 2011)	Bado et al., 2005	No	N/A	N/A
NEMATODES[7]					
Heterodera sp.	EC (Brito, 2002)	Brito, 2002	Yes	R (Brito, 2002)	No
Meloidogyne hapla Chitwood	EC, US (CABI, 2011)	Ferris, 2011	No	N/A	N/A
Meloidogyne incognita (Kofoid & White) Chitwood	EC (CABI, 2011; MAG and IICA, 2001); US (CABI, 2011)	Ferris, 2011; MAG and IICA, 2001	No	N/A	N/A
Meloidogyne sp.	EC (MAG and IICA, 2001; SESA and CORPEI, 2005)	CAF, 1992; MAG and IICA, 2001	Yes	R (SESA and CORPEI, 2005)	No
Pratylenchus sp.	EC (MAG and IICA, 2001)	MAG and IICA, 2001	Yes	R (Ferris, 2011)	No
Tylenchorhynchus sp.	EC (MAG and IICA, 2001)	MAG and IICA, 2001	Yes	R (Ferris, 2011)	No
FUNGI and CHROMISTANS[8]					
Alternaria alternata (Fries: Fries) Keissler Syn.: *A. tenuis* Nees	EC (MAG and IICA, 2001; Pacin et al., 2002; Rogg, 2000); US (Farr and Rossman, 2011)	MAG and IICA, 2001; Rao and Subramoniam, 1976	No	N/A	N/A

[7] Nematode classification and nomenclature are written according to Nemabase (Ferris, 2011).
[8] Fungal classification and nomenclature are written according to SMML (Farr and Rossman, 2011).

Pest Scientific Name	Geographic distribution[1]	Reported on *P. peruviana*	Quarantine pest[2]	Plant part association[3]	Follow pathway
Alternaria solani Sorauer	EC (MAG and IICA, 2001; Rogg, 2000); US (Farr and Rossman, 2011)	CAF, 1992; Farr and Rossman, 2011; MAG and IICA, 2001	No	N/A	N/A
Alternaria sp.	EC (MAG and IICA, 2001; SESA and CORPEI, 2005)	MAG and IICA, 2001	Yes	H (MAG and IICA, 2001); L (SESA and CORPEI, 2005)	Yes
Ascochyta sp.	EC (MAG and IICA, 2001)	MAG and IICA, 2001	Yes	L (MAG and IICA, 2001)	No
Asteridiella inermis (Kalchbr. & Cooke) Hansf. Syn.: ***Irene inermis*** (Kalchbr. & Cooke) Theiss. & Syd.	EC (Farr and Rossman, 2011)	Farr and Rossman, 2011; Raabe et al., 1981; USDA and ARS, 1970	Yes	L (Raabe et al., 1981)	No
Athelia rolfsii (Curzi) Tu & Kimbrough Syn.: ***Corticium rolfsii*** Curzi	EC, US (CABI, 2011)	Farr and Rossman, 2011	No	N/A	N/A
Boeremia exigua var. exigua (Desm.) Aveskamp, Gruyter & Verkley Syn.: ***Phoma exigua*** Desm.	EC, US (Farr and Rossman, 2011)	Manaaki Whenua - Landcare Research, 2011	No	N/A	N/A
Botryotinia fuckeliana (de Bary) Whetzel Anamorph: ***Botrytis cinerea*** Pers.:Fr.	EC (Chamorro and Orellana, 2007; MAG and IICA, 2001); US (Farr and Rossman, 2011)	Angulo, 2003; MAG and IICA, 2001	No	N/A	N/A
Cercospora physalidis Ellis Syn.: ***C. capsici*** Heald & F.A. Wolf	EC (Vaughan, 1982); US (Farr and Rossman, 2011)	Zapata et al., 2002	No	N/A	N/A
Chondrostereum purpureum(Pers.:Fr.) Pouzar Syn.: ***Stereum purpureum*** Pers. : Fr.	EC, US (Farr and Rossman, 2011)	Farr and Rossman, 2011	No	N/A	N/A
Cladosporium oxysporum Berkerley and M.A. Curtis	EC,US (Farr and Rossman, 2011)	Rao and Subramoniam, 1976	No	N/A	N/A
Cladosporium sp.	EC (MAG and IICA, 2001)	MAG and IICA, 2001	Yes	H (MAG and IICA, 2001)	Yes

Pest Scientific Name	**Geographic distribution[1]**	**Reported on *P. peruviana***	**Quarantine pest[2]**	**Plant part association[3]**	**Follow pathway**
Corynespora cassiicola (Berk. & M.A. Curtis) C.T. Wei	EC (RBG, 2011; MAG, 1986); US (Farr and Rossman, 2011)	Wellman, 1977	No	N/A	N/A
Entyloma australe Speg.	EC (Læssøe and Petersen, 2011); US (Farr and Rossman, 2011)	Farr and Rossman, 2011; Manaaki Whenua - Landcare Research, 2011	No	N/A	N/A
Fumago vagans Pers.	EC, US (Farr and Rossman, 2011)	Wellman, 1977	No	N/A	N/A
Fusarium oxysporum Schlechtendahl	EC (MAG and IICA, 2001; Ochoa and Ellis, 2002); US (Farr and Rossman, 2011)	Angulo, 1988; Brito, 2002; MAG and IICA, 2001	No	N/A	N/A
Fusarium sp.	EC (SESA and CORPEI, 2005)	Rao and Subramoniam, 1976; SESA and CORPEI, 2005	Yes	R (SESA and CORPEI, 2005)	No
Gibberella intricans Wollenw. Syn: ***Fusarium equiseti*** (Corda) Sacc.	EC (Ramírez et al., 2006); US (Farr and Rossman, 2011)	Rao and Subramoniam, 1976	No	N/A	N/A
Globisporangium intermedium (de Bary) Uzuhashi, Tojo & Kakish. Syn: ***Pythium intermedium*** de Bary	EC (Brito, 2002); US (Farr and Rossman, 2011)	Brito, 2002	No	N/A	N/A
Globisporangium rostratum (E.J. Butler) Uzuhashi, Tojo & Kakish Syn.: ***Pythium rostratum*** E.J. Butler	EC (Brito, 2002); US (Farr and Rossman, 2011)	Brito, 2002	No	N/A	N/A
Glomerella acutata Guerber & J.C. Correll Syn.: ***Colletotrichum acutatum*** J.H. Simmonds	EC, US (CABI, 2011)	Manaaki Whenua - Landcare Research, 2011	No	N/A	N/A
Golovinomyces cichoracearum (DC.) V.P. Gelyuta Syn.: ***Erysiphe cichoracearum*** DC.	EC (Rogg, 2000); US (Farr and Rossman, 2011)	Farr and Rossman, 2011	No	N/A	N/A

Pest Scientific Name	Geographic distribution[1]	Reported on *P. peruviana*	Quarantine pest[2]	Plant part association[3]	Follow pathway
Leveillula taurica (Lév.) G. Arnaud Syn: *Oidium haplophylli* H. Magn.	EC (Rogg, 2000), US (CABI, 2011)	CABI, 2011; Farr and Rossman, 2011	No	N/A	N/A
Macrophomina phaseolina (Tassi) Goid.	EC (MAG, 1986); US (Farr and Rossman, 2011)	Farr and Rossman, 2011	No	N/A	N/A
Penicillium digitatum (Pers.:Fr.) Sacc.	EC (Rogg, 2000); US (Farr and Rossman, 2011)	Farr and Rossman, 2011	No	N/A	N/A
Penicillium sp.	EC (GPP, 2004);	CAF, 1992; GPP, 2004	Yes	Fr, S (GPP, 2004)	Yes
Phytophthora infestans (Mont.) de Bary	EC (Brito, 2002); US (Farr and Rossman, 2011)	Farr and Rossman, 2011; Tobón and Vásquez, 1998; Vargas et al., 2007; Wellman, 1977	No	N/A	N/A
Phytophthora sp.	EC (Brito, 2002)	Brito, 2002; CAF, 1992	Yes	R, S (Brito, 2002)	No
Pythium sp.	EC (MAG and IICA, 2001)	Brito, 2002; CAF, 1992; MAG and IICA, 2001	Yes	R, S (Brito, 2002)	No
Pythium sulcatum R.G. Pratt & J.E. Mitchell	EC (Brito, 2002); US (Farr and Rossman, 2011)	Brito, 2002	No	N/A	N/A
Ramularia sp.	EC (MAG and IICA, 2001)	MAG and IICA, 2001	Yes	L (MAG and IICA, 2001)	No
Rhizoctonia sp.	EC (SESA and CORPEI, 2005);	CAF, 1992; SESA and CORPEI, 2005	Yes	S (SESA and CORPEI, 2005)	No
Rhizopus stolonifer (Ehrenb.: Fr.) Vuill.	EC (MAG and IICA, 2001); US (Farr and Rossman, 2011)	MAG and IICA, 2001	No	N/A	N/A
Sclerotinia sclerotiorum (Lib.) de Bary	EC (CABI, 2011); US (Farr and Rossman, 2011)	Angulo, 2003; Farr and Rossman, 2011; Manaaki Whenua - Landcare Research, 2011	No	N/A	N/A
Sclerotinia sp.	EC (GPP, 2004),	GPP, 2004	Yes	Fr, S (GPP, 2004)	Yes
Sclerotium sp.	EC (SESA and CORPEI, 2005)	Brito, 2002; SESA and CORPEI, 2005	Yes	S (SESA and CORPEI, 2005)	No
Septoria lycopersici var. *lycopersici* Speg. Syn: ***S. lycopersici*** Speg.	EC (Torres, 2002); US (Farr and Rossman, 2011)	Wellman, 1977	No	N/A	N/A

Pest Scientific Name	**Geographic distribution**[1]	**Reported on *P. peruviana***	**Quarantine pest**[2]	**Plant part association**[3]	**Follow pathway**
Spongospora subterranea f. sp. *subterránea* J.A. Toml.	EC (CABI, 2011); US (CABI, 2011; Farr and Rossman, 2011)	CABI, 2011	No	N/A	N/A
Thanatephorus cucumeris (A.B. Frank) Donk Syn.: ***Rhizoctonia solani*** J.G. Kühn	EC (MAG and IICA, 2001); US (Farr and Rossman, 2011)	Brito, 2002; Farr and Rossman, 2011; MAG and IICA, 2001	No	N/A	N/A
BACTERIA and PHYTOPLASMAS					
Ralstonia solanacearum (Smith) Yabuuchi et al.[9] Syn.: ***Pseudomonas solanacearum*** (Smith) Smith	EC, US (CABI, 2011)	Bradbury, 1986	No	N/A	N/A
Xanthomonas vesicatoria (ex Doidge) Vauterin et al. Syn: ***X. campestris* pv. vesicatoria** (Doidge) Dye	EC (Rogg, 2000); US (CABI, 2011)	Bradbury, 1986	No	N/A	N/A
VIRUSES and VIROIDS[10]					
Colombian datura virus (CDV)	EC (Chellemi et al., 2011); US (Adkins et al., 2008; Chellemi et al., 2011; NAPPO, 2006)	Salamon and Palkovics, 2005	No	N/A	N/A
Cucumber mosaic virus (CMV)	EC (Soler et al., 2005; Valdivieso, 2004); US (CABI, 2011)	Manaaki Whenua - Landcare Research, 2011	No	N/A	N/A
Pepino mosaic virus (PepMV)	EC (Soler et al., 2005); US (CABI, 2011)	AFFA, 2003	No	N/A	N/A
Potato leafroll virus (PLRV)	EC (Rogg, 2000); US (CABI, 2011)	Blanco, 2000	No	N/A	N/A
Potato virus X (PVX)	EC (MAG, 1986); US (CABI, 2011)	Zapata et al., 2005	No	N/A	N/A

[9] The bacteria *Ralstonia solanacearum* is reported on Cape gooseberry without identification of any race or biovar (Angulo, 2003; Bradbury, 1986; Buriticá, 1999; Zapata et al., 2002). The only quarantine (for the United States) R*alstonia solanacearum* race and biovar is race 3 biovar 2 (R3B2) which is not reported in Ecuador (CABI, 2011; Elphinstone, 2005; Priou, 2007). Without further information, we can only consider this to be non-quarantine significant.

[10] Virus classification and nomenclature are written according the Universal Virus Database of the International Committee on Taxonomy of Viruses (Büchen-Osmond, 2010).

Pest Scientific Name	Geographic distribution[1]	Reported on *P. peruviana*	Quarantine pest[2]	Plant part association[3]	Follow pathway
Potato virus Y (PVY)	EC (Ceballos, 1997; MAG, 1986); US (CABI, 2011)	Blanco, 2000	No	N/A	N/A
Tobacco mosaic virus (TMV)	EC (MAG, 1986); US (CABI, 2011)	Manaaki Whenua - Landcare Research, 2011	No	N/A	N/A
Tomato mosaic virus (ToMV)	EC (Caicedo et al., 1997; Soler et al., 2005); US (CABI, 2011)	Singh et al., 1975	No	N/A	N/A
Tomato spotted wilt virus (TSWV)	EC (MAG, 1986; Soler et al., 2005); US (CABI, 2011)	Chagas and Vicente, 1977; Manaaki Whenua - Landcare Research, 2011	No	N/A	N/A
ALGAE					
Cephaleuros virescens Künze	EC (MAG, 1986); US (Brannen, 2006)	Wellman, 1977	No	N/A	N/A

<u>2.4.2. Quarantine pests that are not candidates for further mitigation</u>

General issues. We excluded many of the organisms from further analysis because they did not satisfy the definition of a quarantine pest, or they were unlikely to follow the pathway. For example they pests associated mainly with plant parts other than the commodity; they were associated with the commodity, but were not reasonably expected to remain with the commodity during commercial production/processing; or they were intercepted as biological contaminants during inspection at ports-of-entry but are highly unlikely to be present in the commodity.

Doubtful host association. Organisms about which we could not conclude solely from scant interception data (PestID, 2011) that they attack guava included *Aleurodicus dispersus* Russell (Hemiptera: Aleyrodidae).

The melon thrips, *Thrips palmi* is present in Ecuador (INIAP, 2002), and has been listed as a pest of Cape gooseberry in Colombia (PPQ, 1997). Records from countries where pest and plant co-occur (Flórez et al., 2000; Fischer et al., 2005; SESA and CORPEI, 2005), however, do not indicate that this pest affects Cape gooseberry. *Thrips palmi* has been intercepted 12,253 times on different hosts (PestID, 2011), but never on species of *Physalis*.

In addition, we did not list the pest *Sacadodes pyralis* (Lepidoptera: Noctuidae) above. It has been reported on Cape gooseberry in Ecuador by ACRES (1998); CAF (1992); Condoy and Arteaga (2006), and Gobierno de la Provincia de Pichincha (GPP, 2004) (misspelled as *Secadores piralis*); Cruz and Hernández (2000) and MAG and IICA (2001) (misspelled as *Secadoris pirales*). Despite that, we found no evidence in the literature that this pest attacks any hosts outside the family Malvaceae, and this was confirmed by the Ecuadorian National Plant Protection Organization (SESA, 2007).

Finally, we did not list the *Andean potato mottle virus* (APMoV) (Comoviridae: Comovirus), which is also present in Ecuador (Büchen-Osmond, 2010). Although it has been reported to cause disease in Cape gooseberry in Colombia (Blanco, 2000), that was only under laboratory conditions (Blanco, 2007), and Büchen-Osmond (2010) lists *P. peruviana* as an experimental host.

Organisms Identified Only to Genus. Generally, based on standards by the International Plant Protection Convention (IPPC, 2009), we do not consider risk mitigation measures for organisms identified only to the genus level if the genus in question is reported in the continental United States. Often there are many species within a genus, and we cannot know if the unidentified species occurs in the continental United States and, consequently, whether it meets the definition of a quarantine pest for the continental United States. In this risk assessment, the above statement applies to the arthropod *Heliothis* sp., and the pathogens *Alternaria* sp., *Cladosporium* sp., *Penicillium* sp., and *Sclerotinia* sp. These genera are reported to occur in the continental United States (CABI, 2011; Farr and Rossman, 2011). Lack of specific identification may indicate the limits of current taxonomic knowledge, the life stage, or the quality of the specimen submitted for identification. Pest risk assessments focus on organisms for which biological information is available. Lack of specific identification does not rule out the possibility that a high-risk quarantine pest was intercepted. Conversely, the development of detailed assessments for known pests that inhabit a variety of ecological niches, such as internal fruit feeders or foliage pests, allows effective mitigation measures to eliminate the known organisms as well as similar but incompletely identified organisms that inhabit the same niche. If pests identified to higher taxa are intercepted in the future, we may reevaluate their risk.

<u>2.4.3. Quarantine Pests Likely to Follow the Pathway and Candidates for Further Mitigation</u>

We only identified one such species: *Ceratitis capitata* (Wiedemann) [Diptera: Tephritidae].

2.5. Risk Assessment

In this section we analyze in detail the quarantine pests expected to follow the pathway, i.e., be included in commercial shipments of Cape gooseberry fruit [Steps 5-7 (PPQ, 2000)].

<u>2.5.1. Consequences of Introduction</u>

In this section we assessed the potential consequences of introduction and likelihood of introduction. We determined these ratings using the criteria in the Guidelines for Pathway-Initiated Pest Risk Assessments, Version 5.02 (PPQ, 2000). For each risk element associated with the Consequences of Introduction, we assigned a rating of Low (1 point), Medium (2), or High (3). We calculated a cumulative risk rating by summing the risk element values, and summarized the ratings below (Table 3).

Ceratitis capitata	**Risk ratings**
Risk Element #1: Climate-Host Interaction *Ceratitis capitata* (Medfly) is native to Africa and has spread throughout the	Medium (2)

Ceratitis capitata	**Risk ratings**
Mediterranean region, Southern Europe (e.g., Spain, Italy, Cyprus), the Middle East, Western Australia, South and Central America (e.g., Argentina, Ecuador, Peru, Colombia), and Hawaii (Fletcher, 1989; White and Elson-Harris, 1992). The species can establish in California, Florida, and Texas, where it has been recorded intermittently, and subsequently eradicated (CABI, 2011). Based on a comparison of this reported distribution with a global map of USDA Plant Hardiness Zones (Magarey et al., 2008), we estimate that Medfly could become established in the areas of the continental United States corresponding to USDA Plant Hardiness Zones 8-11. Multiple hosts of Medfly are present in these Plant Hardiness Zones in the continental United States (*Citrus* spp., *Malus* spp., *Prunus* spp., *Pyrus communis*, *P. calleryana*, *Solanum lycopersicum*) (Kartesz, 2011). Because Zone 11 only comprises approximately 0.1 percent of the United States (PERAL, 2008), we do not count it toward the total number of zones for determining the Climate-Host Interaction risk rating. Therefore, we rate this element Medium.	
Risk Element #2: Host Range Medfly is a polyphagous species which has been recorded from cultivated and wild hosts belonging to at least fifty-one genera among at least thirty plant families, including Anacardiaceae (*Anacardium, Mangifera, Spondias*), Annonaceae (*Annona*), Cactaceae (*Opuntia*), Malpighiaceae (*Malpighia*), Moraceae (*Artocarpus, Ficus, Morus*), Myrtaceae (*Eugenia, Feijoa, Psidium, Syzygium*), Punicaceae (*Punica*), Rosaceae (*Malus, Mespilus, Prunus*), Rutaceae (*Citrus*), Sapindaceae, (*Blighia, Euphoria, Litchi*), Sapotaceae (*Chrysophyllum, Manilkara, Mimusops, Pouteria*), Solanaceae (*Capsicum, Solanum*), and Vitaceae (*Vitis*) (CABI, 2011; Liquido et al., 1991; Thomas et al., 2010; White and Elson-Harris, 1992).	High (3)
Risk Element #3: Dispersal Potential A Medfly female may lay up to 800 eggs (22 per day) during her lifetime (Thomas et al., 2010). The life cycle under favorable conditions [21.1 - 32.2ºC (70 - 90°F)] may be completed in 3 weeks; however, under the climatic conditions in Florida (prevailing in the latitude of Orlando), 10 generations could develop under normal year-round conditions (Knapp, 1998). Adult Medfly can fly as far as 32.2 km (20 miles) (Christenson and Foote, 1960; Steiner et al., 1962). Movement of infested commodities is the major means of dispersal to previously uninfested areas (CABI, 2011). Since 1984, inspectors at U.S. ports-of-entry have intercepted Medfly over 3,000 times (PestID, 2011). Medfly may also be dispersed via puparia in soil or growing medium accompanying plants (CABI, 2011).	High (3)
Risk Element #4: Economic Impact Because of its wide distribution and its wide host range, Medfly is ranked as the most important among economically important fruit flies (CABI, 2011; Weems, 1981). It causes reduction of crop yield (Steck, 2006) and may also transmit fruit-rotting fungi (CABI, 2011). Additionally, costs would be incurred to minimize the impact of Medfly on crop production, because the presence of larvae in the fruit may make the fruit unmarketable (Andrew et al., 1977). The	High (3)

Ceratitis capitata	Risk ratings
species is of quarantine significance for many countries (Steck, 2006). Its presence, even as temporary adventive populations, can lead to severe constraints for the export of fruits to uninfested areas in other parts of the world; eradication of recurring populations of Medfly in an area (to maintain pest-free status) can be very costly and resource intensive (Cayol et al., 2002; Steck, 2006).	
Risk Element #5: Environmental Impact Because of its broad host range, Medfly may affect numerous Federal Threatened and Endangered (T&E) plant species in the continental United States [e.g. *Argemone pleiacantha* ssp. *pinnatisecta* (E), *Asimina tetramera* (E), *Berberis nevivii* (E), *Euphorbia telephioides* (T), *Prunus geniculata* (E), *Ribes echinellum* (T)] (USFWS, 2011). However, Medfly only affects the fruit of its hosts. We found no evidence that Medfly damages the seeds or other non-fruit parts of its hosts; therefore, we assume this fruit fly would have little, if any, direct effect on the population health of threatened or endangered plant species. A potential and indirect effect of the establishment of Medfly is the continuance and possible increase in exotic fruit-fly control programs, which would probably include chemical and biological control (USDA-APHIS, 2001; USDA-APHIS. 2011; CABI, 2011; Purcell, 1998; Ovruski et al., 2000; Wharton, 1989). Based on the potential indirect effects of control programs, as opposed to direct damage caused by Medfly, we rate this risk element Medium.	Medium (2)

Table 3. Summary risk ratings for Consequences of Introduction.

Pest	Risk elements					Cumulative risk ratings[a]
	Climate-host interaction	Host range	Dispersal potential	Economic impact	Environmental impact	
Ceratitis capitata	Med (2)	High (3)	High (3)	High (3)	Med (2)	High (13)

[a] Low is 5-8 points, Medium is 9-12 points, and High is 13-15 points (PPQ, 2000).

2.5.2. Likelihood of Introduction

We rated the Likelihood of Introduction based on two separate components. First, we rated the amount of commodity likely to be imported (sub-element 1). Second, we estimated "pest opportunity" using five biological features (sub-elements 2-6). Details of the rating criteria are explained in PPQ (2000). Our sub-element ratings and the overall values for the Likelihood of Introduction are summarized in Table 5.

Quantity of commodity imported annually. The likelihood that an exotic species will arrive in the United States is related to the volume of a commodity shipped to the United States. The cultivated area of Cape gooseberry in Ecuador is not known, but it is estimated that the quantity of this commodity exported annually the first year to the United States could be not more than the quantity (10.96 metric tons) that was exported to other countries by Ecuador in 2006 (SESA, 2007). The sea shipping containers that are typically used for estimating the volume of commodity shipments are 40 feet (12.2 m) in length and hold approximately 40,000 pounds (18,182 kg or 20 tons) (FAS, 2003). However, a 40-foot shipping container can contain a maximum of 5 tons (fruit with husk) or 13 tons (fruit without husk) of Cape gooseberries (Florez, 2007). The annual quantity of Cape gooseberry to be shipped from Ecuador would be less than 10 shipping containers (40 ft) per year. This equates to a Low rating.

Survive post-harvest treatment. For this sub-element, post-harvest treatment refers to any manipulation, handling, or specific phytosanitary treatment to which the commodity is subjected. There is no specific post-harvest treatment proposed to control, reduce, or eliminate this pest species. Consequently Medfly is highly likely to survive regular post-harvest treatments, so we rated it **High**.

Survive shipment. The low temperatures of 4 to 8°C (39.2 to 46.4°F) used during storage and transportation (maritime or aerial) of Cape gooseberry (MAG and IICA, 2001) are not intended to mitigate the pest. Due to the short distance between Ecuador and the continental United States, the duration of low temperatures during transport does not control, reduce, or eliminate this pest species. Fruit fly larvae within fruits can survive shipments when exported without mitigating treatment, as it is shown by numerous interceptions at U.S. ports-of-entry with other fruits (PestID, 2011). Therefore, we rated Medfly High risk.

Not be detected at the port-of-entry. Ecuador does not have a point-of-origin protocol for fruit inspection. In addition to this, internal feeders, such as fruit flies, are difficult to detect during non-targeted USDA inspection procedures at ports-of-entry (Gould, 1995). Because it is highly likely that internal feeders escape detection at ports-of-entry, the risk associated with the inability to detect Medfly is **High**.

Imported or moved subsequently to an area with an environment suitable for survival. Risk ratings for this sub-element are based on the proportion of the commodity that is likely to move to locations suitable for pest survival. Cape gooseberries from Ecuador are likely to be sold in every continental U.S. state. However, the demand for Cape gooseberry fruit is likely focused in certain areas of the United States such as California, Texas, Florida, and New York where high populations of descendants from countries where this fruit is consumed as part of their diet exist (Ennis et al., 2011). Furthermore, if demand for this product is assumed to be proportional to the size of the consumer population in potential markets, then imports might be concentrated more in some regions of the United States than in others, not all of which may be conducive to pest survival. Forty-three percent of the U.S. population resides in states wholly or partly within Plant Hardiness Zones 8 or above (PERAL, 2008). Based on this assumption, areas suitable for these pests to establish permanent populations will likely include part of the country in the South and along the West Coast of the continental United States. Hosts of Medfly and suitable temperatures for its reproduction would be available in those areas. Therefore, we rated the pest **High**.
Come into contact with host material suitable for reproduction. Even if the final destination of infested commodities is suitable for pest survival, pests must still come into contact with suitable host material. This process depends on two factors: the pest’s potential for dispersal and the presence of host material in the region. If Medfly enters the continental United States, it is highly likely to find numerous hosts available for reproduction (NRCS, 2011) in the areas suitable for its reproduction, due to its polyphagous nature and high dispersal potential. Therefore, we rated it **High**.

Table 5. Risk ratings for Likelihood of Introduction.

Pests	Sub-Elements						Cumulative risk ratings[a]
	Quantity Imported Annually	Survive Post-Harvest Treatment	Survive Shipment	Not Detected at Port of Entry	Moved to Suitable Habitat	Contact with Host Material	
Ceratitis capitata	Low (1)	High (3)	High (3)	High (3)	High (3)	High (3)	High (16)

[a] Low is 6-9 points, Medium is 10-14 points, and High is 15-18 points (PPQ, 2000).

3. Pest Risk Potential and Conclusion

We summed the Consequences of Introduction and the Likelihood of Introduction values to find the Pest Risk Potentials, recorded below (Table 6). Pest Risk Potential is a baseline estimate of the risks associated with importation of the commodity in the absence of phytosanitary mitigation measures beyond standard post-harvest processing. We found a pest risk potential of High for Medfly (*Ceratitis capitata*). A High rating indicates that specific phytosanitary measures, supplemental to port-of-arrival inspection, are strongly recommended.

APHIS risk management programs are risk-based and dependent on the availability of appropriate mitigation methods. Details of APHIS risk management programs are published primarily in the *Federal Register* as quarantine notices. The choice of appropriate measures to mitigate risks is part of the Risk Management within APHIS and is not discussed in this document.

Table 6. Pest Risk Potentials for quarantine pests on Cape gooseberry from Ecuador.

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potentials[a]
Ceratitis capitata	High (13)	High (16)	High (29)

[a] Low is 11-18 points, Medium is 19-26 points, and High is 27-33 points (PPQ, 2000).

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5. Appendices

Appendix A. Pests intercepted on *Physalis peruviana*, Cape gooseberry, from 1984 to 2011.

Pests from any country, by host part and where intercepted (PestID, 2011). Data include live pest stages as follows: AI= Alive Immature; AP= Alive Pupae; AA= Alive Adult.

Pest	Origin	Host Part	Where intercepted	Pest Stage (no).	No.
Agromyzidae, Species of	Mexico	Fruit	Permit cargo	AI (1)	1
Aleurodicus dispersus	Hawaii	Leaf	Baggage	AP (10)	1
Arhopalus sp.	Mexico	Fruit	Permit cargo	AI (1)	1
Asteraceae, Species of	Mexico	Fruit	Mail	-	1
Blapstinus sp.	Mexico	Fruit	General cargo	AA (1)	1
Chaectonema sp.	Mexico	Fruit	Permit cargo	AA (1)	1
Chloropidae, Species of	Mexico	Fruit	Permit cargo	AI (1)	1
Chrysomelidae, Species of	Mexico	Fruit	Permit cargo	AI (1)	1
Cicadellidae, Species of	Hawaii	Leaf	Baggage	AI (3)	1
Cladosporium sp.	India	Petal	Baggage	-	1
Copitarsia sp.	Mexico	Fruit	Baggage, Permit cargo	AI (19)	16
Diptera, Species of	Mexico, New Zealand	Fruit	Baggage, General cargo, Permit cargo	AI (14)	3
Gelechiidae, Species of	Mexico, New Zealand	Fruit	Baggage, Permit cargo	AI (6)	4
Geometridae, Species of	Mexico	Fruit	Permit cargo	AI (1)	1
Gryllus sp.	Mexico	Fruit	Permit cargo	AA (1)	1
Lema sp.	Mexico	Fruit	Permit cargo	AI (1)	1
Lineodes integra	Mexico	Fruit	Permit cargo	AI (1)	1
Lineodes sp.	Mexico	Fruit	Permit cargo	AI (1)	1
Lonchaeidae, Species of	Mexico	Fruit	Permit cargo	AI (14)	1
Lygaeoidae, Species of	Mexico	Fruit	Permit cargo	AI (2)	2
Monoxia sp.	Mexico	Fruit	Permit cargo	AA (1)	1
Noctuidae, Species of	Mexico	Fruit	Permit cargo	AI(5) / AP (1)	4
Phomopsis sp.	New Zealand	Fruit	Permit cargo	-	1
Psyllidae, Species of	Mexico	Fruit	Permit cargo	AI (1)	1
Pyralidae, Species of	Mexico	Fruit	Baggage, Permit cargo	AI (3)	3
Rhagoletis sp.	Mexico	Fruit	Permit cargo	AI (5)	5
Syrphidae, Species of	New Zealand	Fruit	Permit cargo	AI (1)	1
Tarsonemus sp.	Mexico	Fruit	Permit cargo	AA (10)	2
Tephritidae, Species of	Mexico	Fruit	Baggage	AI (2)	2
Thripidae, Species of	Mexico	Fruit	Permit cargo	AA (1)	1
Trichobaris sp.	Mexico	Fruit	Permit cargo	AI (1)	1
Xestocephalus sp.	Mexico	Fruit	Permit cargo	AA (1)	1

Appendix B. Additional Commodity information

B1. Botany

Cape gooseberry is herbaceous, growing as an annual in temperate regions and as a perennial in the tropics. It usually reaches 1.6-0.9 m (2-3 ft) in height but occasionally may attain 1.8 m (6 ft). This plant has ribbed, often purplish, spreading branches, and nearly opposite, velvety, heart-shaped, pointed, randomly-toothed leaves that are 6-15 cm (2.4-5.9 in) long and 4-10 cm (1.6-3.9 in) wide. The bell-shaped, nodding flowers are 2 cm (0.8 in) wide, yellow with five dark purple-brown spots in the throat, and cupped by a purplish-green, hairy, inedible husk made of five-pointed sepals. After the flower falls, the calyx expands, ultimately forming a straw-colored husk much larger than the fruit it encloses. The berry is globose, 1.25-2 cm (0.5-0.8 in) wide, weighing 4 to 10 g (0.009-0.022 lb), with smooth, glossy, orange-yellow skin and a juicy pulp containing numerous, small, yellowish, edible seeds (Ligarreto et al., 2005; Morton, 1987).

B2. Plant origin and distribution

The Cape gooseberry is native to Peru and Ecuador (Ligarreto et al., 2005). From Chile to Colombia it also grows as a wild and semi-wild plant in the high zones (Ligarreto et al., 2005). It is also widely cultivated and/or present and naturalized in South and central Africa (Gabon, Kenya, and Zimbabwe), Australia, Hawaii, Malaysia, Melanesia, New Zealand, Polynesia, the Philippines (in the Luzon island) and Tasmania (at the North); in Europe, Austria, England, central Europe (the Czech Republic), Portugal (in the Açores islands), Italy, Macaronesia, and Spain; in Asia, China, and India, and in the mid-east in Israel (EPPO, 2007; Ligarreto et al., 2005; Morton, 1987; Novoa et al., 2006; USDA and ARS, 2011). Cape gooseberry was reportedly first grown commercially in England in 1774 and was cultivated by early settlers at the Cape of Good Hope (in South Africa) before 1807 (CRFG, 1997). Soon after its adoption in Africa, it was carried to Australia and there acquired its common English name, Cape gooseberry (Morton, 1987).

B3. Ecophysiology

In the wild, in England, the plants have been undamaged by a temperature of -3°C (26.6°F). However, in South Africa, plants were not tolerant and failed to recover after a temperature drop to -0.75°C (30.5°F). In southern California, the Cape gooseberry can persist for several years only in frost-free areas (CRFG, 1997). As a crop, in Colombia and Ecuador, it grows at temperatures of 13 to 17°C (55.4 to 62.6°F) and 13 to 18°C (55.4 to 64.4°F), respectively (Fischer, 2000; MAG and IICA, 2001). In Colombia, it does not resist low temperatures, and, after a short-duration frost, can re-sprout (Fischer, 2000). In Colombia, Cape gooseberry requires annual rainfall between 1,000 and 1,800 mm (39.4 and 70.9 in) and a relative humidity of 70 to 80 percent (Fischer, 2000). In Ecuador, the requirements are annual precipitations of 600 to 1000 mm (23.6 to 39.4 in), and a relative humidity between 80 and 90 percent (MAG and IICA, 2001).

B4. Fresh fruit export

Fresh Cape gooseberry fruit from Ecuador is exported in boxes containing small plastic baskets each containing 100 or 125 g (0.22 and 0.28 lbs) of fruit (SESA, 2007). Boxes weighing 1.6 to 2.5 kg (3.53 to 5.51 lbs) are used for bulk exports. The fruits can be stored at 4 to 8°C (39.2 to 46.4°F), with a relative humidity of 80 to 90 percent (MAG and IICA, 2001).